NASA STTR 2010 Phase I Solicitation

T6 Johnson Space Center

To accomplish the Agency's goals and objectives for a robust space exploration program, innovative technologies and approaches are needed to meet these major challenges for human space explorers. This topic solicits technologies to support inflatable modules and advanced portable sensor technologies for high-purity oxygen determination. These technology innovations could help minimize launch mass, size and costs. The anticipated proposed technologies shall have a dramatic impact on achieving NASA's goals.

Subtopics

T6.01 Inflatable Modules

Lead Center: JSC

This subtopic solicits innovative structural concepts that support the development of lightweight structures technologies that could be applicable to space applications. The targeted innovative lightweight structures are for primary pressurized volumes. Innovations in technology are needed to minimize launch mass, size and costs, while increasing operational volume and maintaining the required structural performance for loads and environments.

Of particular interest are inflatable structures, which are viable solutions for increasing the volume in habitats, airlocks, and potentially other crewed vessels. To build confidence in the use of these structures; design, analysis and manufacturing methods that produce optimal structure on a consistent basis need development above the current state of the art.

The development, analysis, and testing of dual purpose materials that show significant benefits in more than one area such as structural, thermal protection, micrometeoroid/ orbital debris protection, radiation protection, atomic oxygen protection, and such are of particular interest.

The folding, packaging and deployment of multi-layer systems especially those with an integrated window or hatch penetration and particularly those of a torus shape surrounding a cylindrical body are also an area of interest.

Also of interest are low permeable bladder materials and the development and testing of a low permeable interface between a gas barrier and a structural core or hatch penetration that is durable over time and does not degrade due to effects such as cold flow. Development of low permeability bladder materials that can tolerate flexure at cold temperatures are of particular interest.

Developments can include material development and testing, conceptual design and demonstration, analysis methods and verification, and/or manufacturing techniques. Technological improvements focus on risk reduction/mitigation, and development of reliable yet robust designs under this announcement. Research demonstrates the technical feasibility during Phase I and shows a path toward a Phase II hardware demonstration, and when possible, delivers a demonstration unit for functional and environmental testing at the completion of the Phase II contract.

T6.02 Advanced Portable Sensor Technology for High-Purity Oxygen Determination

Lead Center: JSC

Determining the purity of oxygen near 100% is problematic using portable electrochemical sensor-based devices. Accurate laboratory analysis is based on techniques such as separation (e.g., gas chromatography, GC) followed by peak integration or mass-spectral analysis. Though accurate, these devices are not readily portable, usually delicate and often require a carrier or calibration gas. While not specifically excluded, a carrier gas is strongly discouraged and calibration should require a minimum of consumables.

This solicitation seeks a reliable technique that can be applied to accurately assess oxygen purity in the range of 99.0% to 99.7% (see an example below)*. The technique or technology should be able to determine oxygen purity with a variety of simple diluents such as nitrogen, argon, hydrogen, water vapor and trace amounts of low molecular weight organics, CO and/or CO_2. It is not important that the technique specifically identify or quantify the diluents(s). The target accuracy for oxygen purity in the range is 0.05%.

Proposed technologies should be easily calibrated in remote locations, should be highly resistant to drift (i.e., long time between calibration cycles) and have potential to be adapted to a size and portability suitable to space missions. Potential applications include on-orbit determination of high-purity oxygen or other remote applications. A minimum of support equipment, maintenance, power and consumables is a key characteristic sought.

The first phase should address potential approaches with anticipated ranges of accuracy and precision along with known or potential limitations and interferences. Subsequent phase will be to develop and demonstrate a working prototype.

Example: The proposed technology should be able to reliably determine and differentiate the oxygen concentration between the following two example gas streams:

- 99.7% Oxygen, 0.2% Argon, 0.1% Nitrogen with a dew point of -60°C;
- 99.4% Oxygen, 0.4% Argon, 0.2% Nitrogen with a dew point of -40°C.